answer to this circular numerous subscriptions were sent in, and the Council has already obtained many necessary and standard works.

Since the last Annual General Meeting in January, 1883, 377 additions have been made to the Library. In no previous year of the Society's existence has such a number of donations been received. Early in February the Smithsonian Institution generously presented a number of its "Contributions to Knowledge," and "Miscellaneous Collections;" and the Imperial Academy of Science of St. Petersburg sent 17 volumes of its publications. Later in the year, the Imperial Zoological and Botanical Society of Vienna forwarded a nearly complete set (35 volumes) of its well-known "Verhandlungen;" the Entomological Society of London, unsolicited, replaced the volumes of its Transactions, which were lost in the Garden Palace fire; Dr. James Cox presented a large collection of Natural History publications; and Professor W. J. Stephens 21 volumes of Dr. Petermann's "Geographische Mitthelungen." Many other valuable works were received from the Hon. William Macleay, Hon. P. G. King, and others; and every month during the year we have been indebted to a large number of Societies and individuals for works which will prove of the greatest service to the working members of the Society. Besides the above, Mr. Henry Deane, M.A., A.M.I.C.E., has lent a complete set of the Palæontographical Society's Proceedings, 30 volumes of the Proceedings of the Zoological Society of London, 18 volumes of the Journal of the Royal Microscopical Society, and several other works.

You will be glad to hear from the Honorary Treasurer, the Hon. James Norton, M.L.C., that the Council will commence the business of the new year with a balance in hand of £179 12s. 1d.

The following is a list of the Papers read at the Monthly Meetings during the year 1883:—

1. "On a new form of Mullet from New Guinea." By William Macleay, F.L.S., &c.

2. "On the Anatomy of the Urogenital Organs in Females of certain species of Kangaroo" (No. 2). By J. J. Fletcher, M.A., B.Sc.

3. "On the remains of an extinct Marsupial." By Charles W. De Vis, B.A.

4. "Contributions to the Zoology of New Guinea," Part VII. By E. P. Ramsay, F.L.S.

5. "On a new species of Tree Kangaroo from New Guinea." By the same author.

6. "On some habits of *Pelopœus lætus* and a species of *Larrada*." By H. R. Whittell.

7. "On the voracity of a species of *Heterostoma*." By the same author.

8. "On the Coal Flora of Australia." By the Rev. J. E. Tenison-Woods, F.L.S., F.G.S.

9. "Further contributions to the Flora of Queensland." By the Rev. B. Scortechini, F.L.S.

10. "Descriptions of two new Fungi." By the Rev. Carl Kalchbrenner.

11. "Notes on the Fructification of the Bunya-Bunya in Sydney." By the Hon. James Norton, M.L.C.

12. "Descriptions of some new Fishes from Port Jackson." By E. P. Ramsay, F.L.S.

13. "Notes on the Tuena Gold-Reefs." By F. Ratte, Mining Engineer. (Read by the President.)

14. "Occasional Notes on Plants indigenous in the immediate neighbourhood of Sydney," No. 3. By Edwin Haviland.

15. "On tooth-marked bones of extinct Marsupials." By Chas. W. De Vis, B.A.

16. "On *Brachalletes Palmeri*, an extinct Marsupial." By the same author.

17. "On the habits of the 'Mallee Hen' *(Leipoa Ocellata)*." By K. H. Bennett.

18. "Notes on a collection of Fishes from the Burdekin and Mary Rivers, Queensland." By William Macleay, F.L.S., &c.

19. "Notes on a viviparous Lizard." By J. J. Fletcher, M.A., B.Sc.

20. "Notes on a method of obtaining water from Eucalyptus roots, as practised by the natives of the country between the Lachlan and Darling Rivers." By K. H. Bennett.

21. "Notes on a lower jaw of *Palorchestes Azael.*" By Chas. W. De Vis, B.A.

22. "Synonymy of Australian and Polynesian Land and Marine Mollusca." By John Brazier, C.M.Z.S., &c.

23. "On some Mesozoic Fossils from Central Australia." By the Rev. J. E. Tenison-Woods, F.G.S., F.L.S.

24. "Contribution to a knowledge of the fishes of New Guinea." No. 4. By William Macleay, F.L.S.

25. "A second half-century of Plants new to South Queensland." By the Rev. B. Scortechini, F.L.S.

26. "Descriptions of new genera and species of Fishes." By Chas. W. de Vis, B.A.

27. "A fourth paper on Plants indigenous in the immediate neighbourhood of Sydney." By E. Haviland.

28. "Localities of some species of Polynesian recent Mollusca." By John Brazier, C.M.Z.S.

29. On the Myology of the Frilled Lizard," (*Chlamydosaurus Kingii*). By Chas. W. De Vis, B.A.

30. "Descriptions of Australian Microlepidoptera," No. 9. By E. Meyrick, B.A.

31. "Some remarks on the action of Tannin on Infusoria.' By Harry Gilliat.

32. "On a fossil Calvaria." By Chas. W. De Vis, B A.

33. "Remarks upon the skull of an Australian aboriginal from the Lachlan District." By Baron N. de Miklouho-Maclay.

34. "On a very dolichocephalic skull of an Australian aboriginal." By the same author.

35. "On a fossil humerus." By Chas. W. De Vis, B.A.

36. "Notices of some undescribed species of Coleoptera from the Brisbane Museum." By William Macleay, F.L.S., &c.

37. "Occasional Notes on Plants indigenous to the immediate neighbourhood of Sydney," No. 5. By Edward Haviland.

38. "Notes on the temperature of the body of the *Echidna hystrix.*" By Baron N. de Miklouho-Maclay.

39. "On the Plagiostomata of the Pacific," Part II. By Baron N. de Miklouho-Maclay and William Macleay, F.L.S., &c.

40. "Notes on some Reptiles from the Herbert River, Queensland." By William Macleay, F.L.S., &c.

41. "Notes on some customs of the aboriginal tribes of the Albert District, New South Wales." By C. S. Wilkinson, F.G.S., F.L.S., President.

42. "On the Brain of Grey's Whale (*Kogia Greyi.*") By William A. Haswell, M.A., B.Sc.

43. "On a New Genus of Fishes from Port Jackson." By William Macleay, F.L.S., &c.

44. "Some Fishes of New Britain and the adjoining islands." By Chas. W. De Vis, B.A.

45. "Some results of Trawl fishing outside Port Jackson." By William Macleay, F.L.S., &c.

46. "On the localities of some Plants from the southern parts of New South Wales." By Baron Ferd. von Mueller, K.C.M.G., F.R.S., &c.

47. "Descriptions of Australian Microlepidoptera," No. 10. By E. Meyrick, B.A.

48. "Notes on the Geology of the Southern Portion of the Clarence River Basin." By Professor Stephens, M.A.

49. "Dimensions of some gigantic Land Tortoises." By J. C. Cox, M.D., F.L.S., &c.

The proceedings of the Society during the year have been published with their customary regularity. This gratifying result is due almost entirely to the untiring energy of the Honorary Secretaries, the Hon. W. Macleay and Professor Stephens, to whom we also owe the printed Monthly Abstract of Proceedings, by which, within two days after each meeting, the members receive a brief but accurate account of all that transpires.

Another part—Part 8—of *Australian Orchids*, by R. D. Fitzgerald, F.L.S., has just been issued from the Government Printing Office. In Part 7, which completes the first volume, there is a Synopsis of the 29 genera and 104 species described, giving in tabulated form, the authorities for the nomenclature, localities, and the characters of the orchids; to this is added a Synopsis of distribution. In this beautifully illustrated work the marvellous

arrangements for the fertilization of the flowers, by insects and other agents, are described; and it is interesting to know that out of the 104 species above-mentioned, 93 are fertilized by insects, the remainder being self-fertilized.

I am glad to see that this subject has also been taken up by another of our members, Mr. E. Haviland, who has contributed several papers, giving the result of his observations upon certain plants indigenous to the immediate neighbourhood of Sydney. When the processes have been discovered by which the varied, beautiful and to us useful forms of plant life are developed, who shall say what benefits may not result in the production of improved varities of fodder plants, cereals, fruits, and flowers, when these processes, which are now dependent upon the instincts of insects, &c., shall have been directed by the intelligence of man. What has already been accomplished in this direction warrants the belief that this is one of the most important subjects that can engage the attention of Naturalists.

An English translation by D'Arcy W. Thompson, B.A., of Professor Hermann Müller's great work on the *Fertilization of Flowers*, has been published during the past year. The value of this translation is perhaps enhanced from the fact that the systematic part of the book, which is arranged on Endlicher's system in the German edition, has been re-arranged according to Bentham and Hooker's *Genera Plantarum*. In reference to cross-fertilization Professor Müller says :—"The good effect of cross-fertilization may be recognized, not only in the structure of insect-fertilized flowers, but also in the water-fertilized and the wind-fertilized plants which preceeded them. . . . . Insects in cross-fertilizing flowers endow them with an offspring which in the struggle for existence vanquish those individuals of the same species which are the offspring of self-fertilization. The insects must therefore operate by selection in the same way as do unscientific cultivators among men, who preserve the most pleasing or most useful specimens, and reject or neglect the others. In both cases selection in course of time brings those variations to perfection which correspond to the tastes or to the needs of the selective agent. Different groups of insects, according to their

sense of taste or colour, the length of their tongues, their way of movement and their dexterity, have produced various odours, colours, and forms of flowers; and insects and flowers have progressed together towards perfection. . . . . The forms, colours, and odours of the flowers in a particular region must depend in the closest manner upon the insect fauna of the region, and especially upon the relative abundance in it of the various classes of insects."

I am informed by Dr. J. C. Cox, President of the Fisheries Commission, that soon after the 15th August, 1882, the Commission wrote to the Trustees of the Australian Museum, asking them to co-operate in preparing a collection of fish fauna for the Fisheries Exhibition intended to be held in London. A large number of exhibits were collected and prepared, but with the exception of one case of exhibits, which were at Mr. Macleay's Museum, all were destroyed with the Garden Palace. The Commissioners then commenced *de novo*, and got together a collection of fishes of all kinds, tinned fish and oysters, smoked fish, and fish products as oils, &c.; a fresh set of paintings of fish were also prepared, together with fishing nets and models of boats.

The Australian Museum also prepared a very large and comprehensive collection of food fishes, &c., in spirits and stuffed; also exhibits of seals and dugong.

The Curator, Mr. E. P. Ramsay, was appointed by the Government to proceed to London to take charge of and arrange the New South Wales Courts; and we must congratulate him upon the result of his efforts; for the exhibits of fish fauna in the New South Wales Court obtained a larger percentage of first and second class awards than those of any other Court, viz.:—13 gold, 10 silver, and three bronze medals, and one diploma of merit.

During Mr. Ramsay's absence Mr. W. A. Haswell, M.A., B.Sc., has been the Acting Curator of the Australian Museum. Besides numerous additions to the collections the following publications have been issued from this institution:—*Catalogue of Library; Catalogue of the Hydroid Zoophytes, by W. M. Bale;*

Catalogue of the collections of Fossils; and *Guide to the contents of the Museum,* which specially points out the arrangements of the different collections.

A question of great importance, and one which this Society must regard with interest, is the sudden spread of Rabbits which have now infected nearly one third of the colony, chiefly in the south-western districts. This immigration is an alarming one, for it is stated that a single pair of rabbits, if they and their progeny were let alone by their enemies, would in the course of three years multiply to more than 3,000,000. In view of the importance and urgency of this matter the Parliament last year passed a measure—"*The Rabbit Nuisance Act,* 1883"—to deal with it in an effective manner.

This Act has now been in force for about seven months, and is working well; but through the shearing intervening, and the prevalence of drought in a good many of the infested districts, the work of extermination has not progressed so rapidly as it would otherwise have done; although it is believed that the spread of the pest has to a large extent been checked.

You will be pleased to hear that since the destruction of the Mining and Geological Museum in the Garden Palace fire, a splendid collection of rocks, minerals, and fossils has been brought together, thanks to the energy of the officers of the Department of Mines and the practical sympathy of many private persons The specimens have been labelled by Mr. J. E. Carne, the Curator, and will at once be available for public display as soon as the Museum accommodation has been provided. From this collection two fine series of specimens, illustrating the mineral resources of New South Wales, have been arranged and sent to the Amsterdam and Calcutta Exhibitions, and these cannot fail to show to the world the varied nature of our mineral wealth.

Recently the Department of Mines has issued a Geological Map of part of the Forest Gold Field, by Mr. H. Y. L. Brown. The main features shown are volcanic flows over granite, metamorphic, Devonian, and Silurian limestones; but in some of

the old valleys and beneath the basalt, occur the Tertiary gold-bearing drifts, and this map, with its accompanying sections, is of special interest as showing the large extent of auriferous country covered by the basalt and which has not yet been prospected.

The inauguration of a system of Technical Education by the Hon. G. H. Reid, M.P., Minister for Public Instruction, is one of the most important events of the past year. A Technical College has for the last four years been successfully conducted by the Committee of the Sydney School of Arts, but this has now been transferred to the Board of Technical Education recently appointed by the Government. A glance at the curriculum issued by the Board will show that the industrial classes have now the means placed within their reach for learning "the science and principles underlying their handicrafts." Instruction has been provided for in several branches of natural history science—botany, geology, &c., and thus this Society cannot but feel a direct interest in a movement which has for its object the application of the principles of science to the industrial arts. Science lectures are to be delivered in the principal towns throughout the colony, which may be the means of calling out the latent abilities of many young persons who may render great service to their country.

The Technological, Industrial and Sanitary Museum of New South Wales, which has been arranged by the energetic Curator, Mr. J. H. Maiden, under the direction of Sir Alfred Roberts, Professor Liversidge, and Mr. Robert Hunt, was opened to the public for the first time in December last. The object of this Museum is to exhibit "typical collections of all materials of economic value belonging to the animal, vegetable and mineral kingdoms, from the raw material through the various stages of manufacture to the final product of finished article ready for use." In connection with the above-mentioned system of Technical Education, this institution must prove of great public utility.

A successful effort has been made during the past year to establish a Geographical Society of Australia, with its headquarters in Sydney, and branches of equal rank in the other colonies. This

young association, of which Professor W. J. Stephens, M.A., is the Vice-President, has already placed itself in communication with the principal Geographical Societies in the old world, and has received gratifying assurances of goodwill and offers of assistance. The question of the exploration of New Guinea, which was proposed as a special object for the operations of the Society, has been placed in abeyance for the present. There can, however, be no doubt that Geographical science will receive valuable acquisitions from the establishment of such a centre of research in this still but partially explored region.

The Zoological Society of Sydney has already achieved very considerable success. Their funds are rapidly augmenting, their grounds and accommodation much increased, and the nucleus of a very valuable and instructive collection of examples of all branches of the animal kingdom has been already formed. Their gardens have become a place of popular resort, and the vigour of the administration promises a great future.

The University of Sydney, which has from the first recognised the importance of Scientific teaching, so far as Chemistry and Physics are involved, and has also introduced the study of Physical Geography and Geology, in accordance with the terms of the late Captain Hovell's bequest, has also, two years ago, added two new schools of Medicine and Science. It has been decided that the first year of the undergraduates course shall be devoted to Arts, whatever be the ultimate destination of his studies, so that the special schools would not commence work before the beginning of the second academical year. And though as yet the numbers are inconsiderable, there is much ground for congratulation as to the steps already secured, and for hope of increased progress in the future. Chemistry and Physics are included in the Arts course of the first year, but Biological studies are deferred to the second. Mr. Macleay has, as usual, offered liberal assistance to the study of Biological Science. He offers each year two Exhibitions of £60 each, tenable for three years, to such aspirants to scientific distinction as shall pass the matriculation examination and satisfy the following conditions:—

1st. They must be *bona fide* residents in the country. 2nd. They must show that they require some extraneous aid in order to live in Sydney and attend the regular lectures. 3rd. They must undertake to complete, to the best of their power, the three year's course, and so proceed to their degree; and that Geology and Biological Science shall form an essential portion of their studies for the degree. These exhibitions are tenable by persons of either sex.

The following Papers were read before the Royal Society of New South Wales during the session of 1883 :—

May 2—President's Address. By Chr. Rolleston, C.M.G.

June 6—On the Aborigines inhabiting the great Lacustrine and Riverine Depression of the Lower Murray, Lower Murrumbidgee, Lower Lachlan, and Lower Darling. By Peter Beveridge.

July 4—On the Waianamatta Shales. By the Rev. J. E. Tenison-Woods, F.G.S., F.L.S., &c.

July 4—Further remarks on Australian Strophalosia, and description of a new species of Aucella from the Cretaceous Rocks of North-east Australia. By Robert Etheridge, junr., F.G.S.

August 1—On Plants used by the Natives of North Queensland, Flinders and Mitchell Rivers, for food, medicine, &c. By Edward Palmer, M.L.A. (Queensland).

September 5—Notes on the genus Macrozamia, with descriptions of some new species. By Charles Moore, F.L.S., V.P.

September 5—A list of Double Stars. By H. C. Russell, B.A., F.R.A.S.

September 5—Some facts connected with Irrigation. By H. C. Russell, B.A., F.R.A.S.

September 5—On the discolouration of white bricks made from certain clays in the neighbourhood of Sydney. By E. H. Rennie, B.A., D.Sc.

October 3—On the Roots of the Sugar-Cane. By Henry Ling Roth, F.M.S., F.S.S.

November 7—On Irrigation in Upper India. By H. G. McKinney, M.E., A.M.I.C.E.

November 7—On Tanks and Wells of New South Wales. Water Supply and Irrigation. By A. Pepys Wood.

December 5—Additions to the Census of the Genera of Plants hitherto known as indigenous to Australia. By Baron Ferd. von Müeller, K.C.M.G., M.D., Ph.D., F.R.S., &c.

The Royal Society offers its Medal and a money prize of £25 for the best communication (provided it be of sufficient merit) containing the results of original research or observation, upon each of the following subjects :—

Series III.—To be sent in not later than September 30th, 1884:

No. 9.—Origin and mode of occurrence of gold-bearing veins and of the associated minerals.

10.—Influence of the Australian climate in producing modifications of diseases.

11.—On the Infusoria peculiar to Australia.

12.—On Water Supply in the *interior* of New South Wales.

The Honorary Secretaries state that the Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward.

With reference to the progress of science in Victoria, Mr. R. L. J. Ellery, F.R.S., Government Astronomer, in his Presidential Address, delivered in September, on the occasion of the commemoration of the 25th session of the Royal Society of Victoria, states "that the several national scientific and technical departments have been in active operation during the year, and with them, as with ourselves, satisfactory progress is manifested. There is an undoubted and general increase in the desire for knowledge in the various pure and applied sciences, and especially as applied to technical training and to the daily requirements of life. Some new Societies for the prosecution of study and research, more especially in natural science, have come into existence in the provinces, and the older societies and schools are increasing in their good influence and usefulness. The School of Technology and Museums, presided over by our talented

member, Mr. Cosmo Newbery, continue doing good work in our midst. The collections of the Industrial and Technological Museum have been largely increased during the past year by the additions of specimens in each section and several new divisions have been formed. It may be mentioned that the knowledge derived from the museum collection of Indian timber has led to the opening of a new trade between this colony and India. Our National Museum already shows signs of being cramped for room, and the Director, Professor McCoy, during the past year, has directed his attention to additions of such classes as occupy small space, and has therefore devoted his work chiefly to the zoological and geographical classification of insects, and in filling up gaps in the collection of shells." Mr. Ellery then refers at some length to "one or two interesting astronomical events. First, the apparition in September of the Great Comet of 1882, then the transit of Venus in December, and subsequently the determination by telegraph of the differences of longitude between Singapore and Port Darwin, and then between Port Darwin, Adelaide, Melbourne and Sydney."

Mr. R. A. F. Murray, Government Geologist of Victoria, has been surveying the country about Rodborough, which is interesting, as containing the northern continuation of the combined Creswick, Kingston, Smeaton and Clunes auriferous lead-systems.

The deep borings for Coal at Port Arlington, Colac, or Coleraine have not been successful in striking a payable seam of coal; but in the eastern mesozoic area a seam up to 2 feet 8 inches thick of first-class coal has been opened, and Mr. Murray considers that it extends for many square miles.

Dr. P. H. Macgillivray, of Sandhurst, has been adding largely to our knowledge of living *Polyzoa*, and has described and illustrated a large number of new species in papers read before the Royal Society.

One of the most indefatigable scientific workers in Australia, is Mr. A. W. Howitt, F.G.S., Police Magistrate of Sale, Victoria. Mr. Howitt has been steadily working out the Geology and Mineralogy of his large district, and has published several papers

in that department, including microscopical examinations of the igneous rocks. He has also been investigating the habits and beliefs of various tribes of Australian aborigines, and several interesting contributions of his have been published in London by the Anthropological Institute.

The second decade of Observations upon New Vegetable Fossils of the auriferous drifts, has been lately issued by the Victorian Government. This is a valuable addition to the former work of Baron Ferd. von Müeller, C.M.G., M.D., Ph. D., F.R.S., F.L.S., etc., Government Botanist, who has done so much towards the elucidation of the Tertiary flora. I am informed that the ninth and tenth decades of the *Eucalyptographia* have been completed by this distinguished botanist, who has also written a supplement to his *Systematic Census of Australian Plants*. It is gratifying to know that *the Select Plants for Industrial Culture and Naturalization*, of which work the Government of New South Wales brought out an enlarged edition in 1881, is passing now for the sixth time in the English language through the Press by the generous interest of Mr. G. Davis, the celebrated scientific publisher of Detroit, Michigan. As a manual for the acclimatization of plants, the work has been translated and slightly altered by Prof. Charl Nandin of Antibes, a member of the Institute of France; Spanish and Portuguese translations are also in progress, for which the Baron has furnished some addenda. The Members of the Society will be glad to learn that the publication on *Papuan Plants* will be continued during the present year as new material has been forwarded to the Baron. The twelfth Volume of the "*Fragmenta*," is now in progress.

In a letter which I have lately received Baron von Müeller makes the following remarks regarding this Society, which with your permission I will read: "The Members of the Linnean Society of New South Wales, will be sad to learn that the venerable George Bentham, who spent a large portion of his valuable time for seventeen years on the elaboration of the *Flora Australiensis*, is by the infirmities concomitant to his high age, prevented from continuing his great labours, which early last year with the

completion of his and Sir Joseph Hooker's *Genera Plantarum* drew to a close. In a letter written in November last to me, he sketched with a few words his brilliant career, which passage I beg to copy with a hope that you will insert it in your Annual Presidential Address, especially as Bentham was for a series of years President of the parent Linnean Society, and I would simultaneously suggest that the Linnean Society of New South Wales may elect this illustrious man, who has done so much for the advancement of the Phytography of your colony, an Honorary Member.

Nov., 1883.

"'My principal object in now writing to you is to say, that this is—I fear—the *last* letter you can receive from me. For the last six months I have been quite disabled from continuing my botanical pursuits and correspondence, and I now see that I can never hope to resume them.

"'I first began collecting and forming my herbarium in 1818; my first botanical work of any importance was my 'Catalogue des plantes des Pyrenees et du Bas Languedoc,' published in 1826; but I had already written on other subjects, and from 1823 to 1828 I published more on classification, on logic, law, etc., than on Botany. From 1828 to 1833 I endeavoured to keep up Botany as well as Law, which I had adopted as a profession. In 1833 I finally gave up Law, and devoted myself thenceforward exclusively to Botany. In 1854 I gave over my Botanical Library and Herbarium to Kew, and for the next 28 years went daily down there (from London) to work, devoting to it six or eight hours a day, five or six days in the week, steadily and continuously, with the sole interruption of an occasional Summer vacation of a few weeks. After however the tedious winter of 1882—1883 I broke down in my 83rd year, and have done nothing since May last. I had however finished my share of the 'Genera Plantarum,' of which you will have received the latest part from Sir Joseph Hooker;—and I have now only, in taking leave of you, to thank you for all the pleasure I have had in my correspondence with you.

Ever yours sincerely

(Signed) GEORGE BENTHAM.'

"The Linnean Society of New South Wales will doubtless wish with me, that the sad presentiments of this great man will not be fulfilled, and that from his unrivalled experience and ardour in the promotion of Phytography we shall benefit until he reaches a Chevreulian age."

We have to congratulate the Royal Society of Queensland upon its inauguration. This Society has been incorporated with the Philosophical Society, which dates its existence from the time when Queensland became a separate province, and which, as the President, the Hon. A. C. Gregory, in his inaugural address delivered on the 8th of the present month, justly remarks, can point to the Queensland Museum as chiefly the result of its labours. I need hardly remind you that it is to the Curator of this successful and popular institution, Mr. Charles W. De Vis, B.A., that we are indebted for several valuable papers read before our Society.

During the year an instructive and valuable work of reference, entitled *A synopsis of the Queensland Flora*, has been published in Brisbane: the author is Mr. Frederick Manson Bailey, F.L.S., Colonial Botanist. A statement of the Fossil Flora of Queensland, by the Rev. J. G. Tenison-Woods, is appended. The arrangement of the work is based upon that of Bentham and Hooker's *Genera Plantarum* and Baron von Müller's *Fragmenta Phytographiæ Australis.*

Mr. R. L. Jack, the Government Geologist of Queensland, has just completed a survey of the Hodgkinson Gold-Fields. Below the water line the reefs here contain a complex mixture of copper and iron pyrites, zinc-blende, galena, &c., which renders the gold difficult of extraction. Consequently some of the companies (like the New Reform Mine at Lucknow, and the Mitchell's Creek Mine near Bathurst), send their stone to England for treatment. In one of the mines he has discovered the *Lepidodendron nothum*, which species occurs in the Star, Mount Wyatt, and other beds along with Upper Devonian or Lower Carboniferous fossils, but does not range so high as the marine beds at the base of the Coal Measures. Also at the Hodgkinson are coarse conglomerates, with pebbles of limestone, containing fossil corals, probably of Upper Silurian species. These facts are very interesting as being the counterpart of what obtains in New South Wales.

The Government Geologist of South Australia, Mr. Y. L. Brown, who was formerly a Member of the Geological Survey of New South Wales, has during the year made an exploration of the eastern portion of the interior of that colony, and his published report with Map and Sections, furnishes some interesting and important information. The objects of this journey were to ascertain the extension from New South Wales into South Australia of the gold-bearing rocks of Mount Brown, and the Cretaceous formation in which Artesian and other water has been found. The extension of the Cretaceous and Tertiary area into this colony from New South Wales and Queensland, was proved along a distance of 225 miles of boundary of the former, and 300 miles of that of the latter colony.

The southerly extension of this great Cretaceous area is limited by the primary rocks which continue in a westerly direction from the Barrier Range in New South Wales. Artesian Wells have been obtained in the Cretaceous formation, and the numerous conical mounds which have been formed by mud springs still flowing as well as by others now extinct, are evidences of natural Artesian Springs. In places these mounds are so numerous as to give the country the appearance of a deserted diggings. The Flinders and other ranges lying to the south of the plain and sandhill country, act as a dam to prevent the subterranean water from reaching the sea ; this gives rise to the natural Artesian Springs, such as Mulligan, Blanchewater, etc. The natural Artesian Wells show that in those localities water will rise to the surface when the water-bearing strata has been pierced.

One of the most marked features of the Cretaceous country are the peculiar sandhills. As to the origin of the sandhills, Mr. Brown says—"I have reason to believe that in many cases, particularly in those of the isolated ridges and mounds traversing the stony desert at long distances apart, the sand has been derived from an underground source through the pressure of subterranean water. There was in all probability an outlet at one time connecting the old Cretaceous sea which occupied the centre of Australia with the ocean. If we suppose a sudden or gradual closing

up of this outlet to have taken place, through the subsidence of the land, or any other cause, the water not having any vent to escape by, would accumulate in the porous strata until under sufficient pressure to force its way to the surface along cracks or through holes caused by such pressure, and bring with it the sand, in a similar manner to the present mud and sand springs. The eruption of sand in large quantities would cause a subsidence of the surrounding area, whereof there is evidence in the valleys of the Cooper and Diamentina, and thus have created the great lakes into which these rivers now flow. About 35 miles south-east of Clifton Hill Station, on the Diamentina, there are two parallel red sand ridges traversing a stony plain in a north-north-westerly direction ; the plain is covered with a pavement-like coating of flinty quartzite stones. On the east side blocks and boulders of the same rock are scattered about, amongst which are numerous low circular mounds of white clayey sand, the centres of which are formed of blocks of stones piled up, which are encircled by other smaller blocks, and these by scattered stones, the whole bearing the appearance of having been erupted by springs from below. At numerous other places similar appearances present themselves ; mounds of sand, gravel, and clay, and scattered stones occurring on the surface of many of the plains and flat areas, the presence of which it is difficult to account for in any other way, as there are no rocks at a higher level in the neighbourhood from which the sand or gravel could have been washed."

As tending to support Mr. Brown's theory I may mention, that great quantities of sand were forced up with the water in the tubes of the artesian bore at Wee Wattah on the Killara Run in the Darling District.

The deep bore which is now being put down in the Cretaceous area to the north of the "Government Gums," by Mr. J. W. Jones, Head of the Water Conservation Department, S.A., has reached to a depth of 1,100 feet in Cretaceous or Jurassic strata without striking water. This is remarkable and shows how great is the depth of this basin. In another locality good water has been found in the Miocene Tertiary formation.

In the early part of the year the Hon. J. L. Parsons, Minister for the Northern Territory, accompanied by Professor Ralph Tate, F.G.S., and others, paid an official visit to the Territory. Mr. Parsons considers that Port Darwin will be the key to the whole of Northern Australia. It contains agricultural lands which, though of limited extent, are suited for the growth of sugarcane, maize, rice, and other tropical plants. And in the interior are extensive pasture-lands.

Professor Tate, in his official report, points out that the rice plant is indigenous to the Northern Territory, as are also the Tamarind and one other useful plant, the *Tacca pinnatifida*, from the tubers of which the main supply of Fiji arrowroot is prepared. He further mentions "that tropical South Australia has been truly said to be a land of grasses; the number of known species is about 130, and of these he collected over 50, between the Adelaide River and Pine Creek. But only some four or five are constituents of the grass plains and adjacent hill slopes. Some flats are almost exclusively occupied with *Anthistiria*, or with *Andropogon triticeus*, or with another congeneric species, whilst not infrequently the three are found in company. The two latter grasses acquire on the flats a height of from 6 to 8 feet, and exceptionally attain to 14 feet; but on dry hill slopes the same species dwindle down to 2 feet or less. The exuberant growth of grasses in the plains of the basin of the Northern Rivers should be capable of keeping alive large herds of cattle.

"The character of the landscape, as far as it depends upon trees, shrubs, and grasses, presents along the whole route very little variation; and it is only by the margins of some of the sluggish water-courses that the vegetation assumes a tropical aspect.

"In the jungles, always of limited area, such as at Famine Bay, near Palmerston, at Rum Jungle, at the Stapleton, and those on the margins of some of the tributaries of the McKinlay River, there abound bamboos, reaching to 40 feet and 60 feet high, screw-pines, umbrageous fig trees, tall eucalyptus, and the paper-bark melaleuca or tea-tree, amongst which climb certain convolvulaceæ, true vines, sarsaparilla vine, &c. The rest of the

country is grassy and lightly timbered. The flats, the soil of which is a stiff clay, have much grass and little timber; the slopes of the hills are covered with a pisolitic iron, quartz sand, gravel; and as we recede from the swampy ground the grass becomes shorter and scantier, and the trees closer and smaller

"The timber is of a scrubby kind, the chief constituents being two or three eucalypti (*E. clavigera*, &c.), Ironwood (*Erythrophlœum Laboucherii*), and *Grevillea-chrysodendron*. There is a general absence of shrubs; and the grasses, which make up the rest of the landscape, if we except the grotesque anthills, which almost equal in height the trees amongst which they occur, are comprised of about 3 species."

Regarding the metalliferous country, Professor Tate describes it as consisting of metamorphic rocks, in the midst of which occur granite, diorite, and porphyritic felstones. This tract comprises an area of 7,800 square miles, the boundaries of which are defined by the desert sandstone, which forms bold escarpments about 600 feet high, and which is the northern edge of the great plateau of Central Australia. Rich gold-bearing quartz reefs occur in the metamorphic rocks, and the alluvium in the neighbouring gullies has been found to be rich in gold. Ores of tin, copper, lead, and iron have been proved in several localities. Professor Tate is, however, of opinion, that these mineral riches will not be profitably worked by European labour, but that their development must be left to the cheaper and more acclimatised labour of the Asiatic tribes under the management of Europeans.

In New Zealand considerable activity has, as usual, been manifested in matters of Science, chiefly by Dr. Hector, C.M.G., F.R.S.; Professor Julius von Haast, F.R.S.; Professor Hutton, F.G.S.; Professor G. Ulrich, F.G.S.; Professor Parker and others. Their labours are chiefly made known in the *Transactions of the New Zealand Institute*, *The New Zealand Science Journal*, and in the publications of the Colonial Museum and Geological Survey Department; one of the latter, which may be mentioned as of general interest, is a third edition of the *Handbook of New*

Zealand, by Dr. Hector, Director of the Geological Survey. In this instructive little work have been collated from the records of the various Government departments and other sources of authority, the most important facts relating to the national history and progress of New Zealand, as well as to its natural history and rich resources.

The disastrous earthquake of Ischia in July last, by which over 4,000 human lives were destroyed, was followed by the still more terrible calamity in the Straits of Sunda in August. The sudden volcanic eruption in the Island of Krakatoa situated in these Straits, produced the enormous tidal waves which overwhelmed a large area of the Western Coast of Java, totally destroying the town of Anjer and many villages, and causing the loss of over 70,000 human beings. This eruption may truly be recorded, not only as a most important event of the year, but also as one of the most remarkable volcanic eruptions on record.

The following is a vivid description of it by Captain W. J. Watson, of the British ship "Charles Bal," who safely navigated his vessel through the Straits during the volcanic outbursts.

"On the 26th August, 1883 at noon wind W.S.W., weather fine, the Island of Krakatoa to the N.E. of us, but only a small portion of the N. E. point, close to the water, showing. Rest of the island covered with a dense black cloud; at 2.30 p.m. noticed some agitation about the point of Krakatoa; clouds or something being propelled from the N.E. point with great velocity; at 3.30 we heard above us and about the island a strange sound, as of a mighty crackling fire, or the discharge of heavy artillery at second intervals of time; at 4.15 p.m., Krakatoa N. ½ E. 10 miles distant observed a repetition of that noted at 2.30, only much more furious and alarming, the matter, whatever it was, being propelled with amazing velocity to the N.E. To us it looked like blinding rain, and had the appearance of a furious squall of ashen hue. At once shortened sail to topsails and foresail; at 5 the roaring noise continued and increasing, wind moderate from the S.S.W., darkness spread over the sky, and a hail of pumice stone fell on us,

many pieces of considerable size and quite warm ; had to cover up the skylights to save the glass, while feet and head had to be protected with boots and South-westers. About 6 the fall of larger stones ceased but there continued a steady fall of a smaller kind, most blinding to the eyes, and covering the decks to three or four inches very speedily, while an intense blackness covered the sky and land, and sea ; sailed on our course until we got what we thought was a sight of Fourth Point light, then brought ship to the wind, S.W., as we could not see any distance and we knew not what might be in the Straits the night being a fearful one ; the blinding fall of sand and stones, the intense blackness above and around us, broken only by the incessant glare of varied kinds of lightning, and the continued explosive roars of Krakatoa, made our situation a truly awful one.

"At 11 p.m, having stood off from the Java shore, wind strong from the S.W., the island, W.N.W. eleven miles distant, became more visible, chains of fire appearing to ascend and descend between the sky and it ; while on the S.W. end there seemed to be a continued roll of balls of white fire ; the wind though strong was hot and choking, sulphureous with a smell as of burning cinders ; some of the pieces falling on us being like iron cinders, and the lead from a bottom of thirty fathoms came up quite warm.

"From midnight to 4 a.m., 27th, wind strong but very unsteady between S.S.W. and W.S.W. the same impenetrable darkness continuing, the roaring of Krakatoa less continuous, but more explosive in sound, the sky one second intense blackness the next a blaze of fire, mast heads and yard arms studded with corposants, and a peculiar pinky flame coming from clouds which seemed to touch the mast heads and yard arms ; at 6 a.m. being able to make out the Java shore set sail, passing Fourth Point light house at 8, hoisted our signal letters but got no answer. 8.30 passed Anjer, name still hoisted, close enough in to make out the houses but could see no movement of any kind ; in fact through the whole Straits we have not seen a single moving thing of any kind on sea or land ; at 10.15 a.m. passed the Button Island to $\frac{1}{2}$ to $\frac{3}{4}$ mile off, sea like glass round it, weather much finer looking and

no ash or cinders falling ; wind to S.E, light. At 11.15 there was a fearful explosion in the direction of Krakatoa, now over thirty miles distant ; we saw a wave rush right on to the Button Island, apparently sweeping right over the South part and rising half way up the North and East sides. This we saw repeated twice, but the helmsman says he saw it once before we looked ; the same wave seemed also to run on to the Java shore ; at the same time the sky rapidly covered in, the wind came strong from the S.W. by S.; by 11.30 we were enclosed in a darkness that might almost be felt, and at the same time commenced a downpour of mud, sand and I know not what, ship going N.E. by N. seven knots per hour under three lower topsails ; put out the side light, placed two men on the look-out forward, while mate and second mate looked out on either quarter, and one man employed in washing the mud off binnacle glass ; we had seen two vessels to the North and N.W. of us before the sky closed in, adding much to the anxiety of our position.

" At noon the darkness was so intense that we had to grope our way about the decks, and although speaking to each other on the poop, yet could not see each other ; this horrible state and downpour of mud, &c., &c., continued until 1.30, the roarings of the volcano, and lightnings being something fearful. By 2 p.m. we could see some of the yards aloft and the fall of mud ceased ; by 5 p.m. the horizon shewed out in the North and N.E., and we saw West Island bearing E. and N. just visible ; up to midnight the sky hung dark and heavy, a little sand falling at times, the roarings of the volcano very distinct, although in sight of the North Watcher and fully sixty five or seventy miles off it.

" Such a darkness and time of it in general few would conceive, and many, I dare say, would disbelieve ; the ship from truck to water line, is as if cemented, spars, sails, blocks, ropes in a terrible mess, but thank God, nobody hurt or ship damaged ; on the other hand how fares it with Anjer, Merak, and other villages on the Java coast !"

As to what happened on the land, I will not venture to add to the graphic description by the Rev. J. E. Tenison-Woods, F.G.S.,

who a few days after the occurrence was fortunate enough to visit and make a personal examination of the scene of disaster, which has been already published in the *Sydney Morning Herald.*

This and other similar convulsions probably originate from the generation of molten matter, gases and steam within the great lines of fracture produced by the contraction of the earth's mass consequent upon its cooling. The volcanic cones mark the position of weak points of resistance upon these shrinkage lines, and give way when the expansive forces of the heated matters becomes excessive. It is not improbable that the outbursts may be accelerated by atmospheric changes ; for instance when the barometer is low, indicating less atmospheric pressure over the volcanic region ; or when as Mr. H. C. Russell, our Government Astronomer, pointed out in a letter to the *Sydney Morning Herald* of 3rd September last, a sudden increase of temperature may affect the earth as it did this year about the period of the meteor shower in August ; for a sudden change in surface temperature must affect the strain under which the earth's surface exists.

The numerous earthquakes and remarkable tidal phenomena observed throughout Australasia at the time and subsequent to the great eruption at Sunda, were no doubt movements sympathetic with that eruption ; for fractures due to shrinkage or expansion in one part of the earth's mass must affect other parts, but the effects would not be simultaneous, as some of the different rock formations owing to their structures would resist the strain longer than others and thus earthquake movements might be felt at various intervals in different localities.

Evidences of fracture in the rocks are frequent in almost all the geological formations : I have counted over 30 dislocations in the Wianamatta beds which are exposed in the railway cuttings between Sydney and Parramatta.

Victoria, especially in the south-western portion, was in the later Tertiary times, the scene of great volcanic activity. No less than 79 extinct points of eruption occur there. Some of these which I have examined are cone-shaped hills, with crater basins, and are built up of basaltic lava, scoria, and ashes. The

Anakies, near Geelong, are three such crater hills, and huge boulders of granite are mingled with the volcanic ashes; one of these boulders is from 10 to 15 feet in diameter. Near the crater of another volcano I have seen fragments of Miocene limestone, containing fossil shells, enclosed in the lava, showing that the latter has come up through the Miocene beds; and under the basalt plains in the same locality occur horizontally stratified beds of volcanic ash, such as we may imagine have lately been deposited in the Straits of Sunda.

In New South Wales volcanic rocks occur, more or less, on almost every part of the Great Dividing Range, both along its summit and upon its eastern and western slopes; but with the exception of Mount Table Top, near Kiandra, the Canoblas, near Orange, and perhaps one or two conical hills in New England, no true crater-hills have been observed. The basaltic lava, in nearly all instances, has welled up through numerous fissure-vents and overflowed from them.

I have before remarked that the researches of this Society are not only of direct scientific value, but will also aid in the development of the economic resources of the colony, or rather, as I should say, of Australasia; for though our home is in New South Wales, and therefore New South Wales will be more immediately benefited, yet the influence of the Society must reach beyond the territorial lines which politically divide the great and naturally united field every part of which must claim our attention. The site of our homestead, being a very central one, has been well selected. Several widely separated portions of Australasia possess rich local resources capable of supporting populous communities, but in no portion do there occur in such abundance and variety the natural elements for the building up of a prosperous nation, as in this central portion of Eastern Australia.

Here within a comparatively small area are included the principal physical features of the Continent; and when we mention that the land features are very varied, a corresponding variety in the climate, the geology, and the fauna and flora may be inferred. And when we also enter the ocean upon our list, and

consider the remarkable contour of its bed, and the great depths which the soundings have shown to exist at no great distance from our shores, we may also infer what marvellous variety there must be in our marine fauna and flora.

In contemplating this rich field, the interest of the naturalist increases almost to excitement when he remembers that both upon the land and in the ocean exist very ancient forms of life linking the present with the distant past; for he here feels himself to be in a region where geological changes have not been so complete as in many other portions of the globe, and that therefore the law which has regulated the gradual out-growth of the present from the past may be studied here perhaps with greater advantage than elsewhere.

My predecessors in the Presidential office to which you have done me the honor of election, have addressed you upon several of the subjects just alluded to; and as they have referred to the practical issue attending the work of this Society in connection with certain industries, I beg that I may be permitted to add a few observations bearing more particularly upon a subject of great scientific and national interest, I mean Economic Geology.

As I shall have to make reference to the different geological formations, I will here mention them in their relative order of superposition.

Recent
Pleistocene
Pliocene
Miocene
Eocene
Cretaceous
Clarence series (Jurassic?)
Wianamatta series } (Triassic?
Hawkesbury series }
Upper Coal Measures (Permian)?
Lower Coal Measures (Carboniferous)
Devonian
Silurian

Basalt, Diorite, Serpentine, Porphyry and Granite.

The five last named rocks, though placed as the lowest in position, and often found as such, are all younger than the lowest of the above-mentioned sedimentary rocks. At all events we have as yet no evidence to the contrary; for wherever the boundaries of the Silurian and granites are well indicated, the latter are observed to be metamorphosed beds of the former; and where the metamorphism has been so great as to have produced semi-fluid conditions, the granites are seen as intrusive masses penetrating the Silurian rocks. I have seen in New England instances of metamorphic granites and porphyries in which the lines of stratification of the original sedimentary formation have not been obliterated; and also, in the same locality, splendid sections shewing intrusive dykes and masses of these rocks. The diorites in like manner have penetrated the Carboniferous rocks; and some of the basalts have in places burst through and overflowed all the formations older than the Pleistocene.

The connection of the older igneous rocks with the sedimentary formations which have been affected by them has had an important influence upon the occurrence of some of our economic minerals. Thus some of the richest deposits occur only where the Silurian and Devonian formations have been disturbed by intrusions of diorite; and the bismuth lodes, also many of the tin lodes, traverse the granite near its junction with the slates; I shall again make reference to these further on.

Coal.

New South Wales is rich in coal, shale, gold, tin, copper, iron and antimony, but of these coal, the value of the annual productions of which now exceeds that of any of the others, may justly be considered of the greatest national importance, and in its development lies the establishment and success of various commercial industries. Fortunately our coal deposits are very extensive and are available in widely separated localities both upon the seaboard and inland. Sydney is situated almost in the centre of a great coal basin, the eastern half of which long ago sunk down and disappeared beneath the ocean, the present coast marking the line of fault. But we can well excuse this fault, for

it has allowed the great water-way of the world access to the rich mineral portion of this territory; and the coal in the remaining half of the broken basin will more than suffice for the needs of many generations.

The Northern, Western, and Southern Coal Fields have been so named from their position in reference to Sydney. The Northern Coal Field includes the seams which are worked in the Newcastle, Maitland, and Greta districts. In the two latter districts the coal seams are in *Glossopteris* beds, the Lower Coal Measures, which rest upon and are overlaid by strata containing marine fauna of Carboniferous age. In the Newcastle district the seams of coal occur in a higher series of plant-bearing strata, about 500 ft. thick and quite devoid of marine fossils. This series is called the Upper Coal Measures, and has been provisionally referred to the Permian period. It includes upwards of six seams of coal, several of which have been worked; but the lowest of them is the principal seam which is from 8 to 15 ft. thick, and it is from this that fully one-half of the coal raised in the colony is obtained. The coal is of a bright bituminous character, quick-lighting and suitable for steam, gas, smelting, and household purposes. The same Coal Measures extend for a considerable distance in a southerly direction, and some of the seams not only crop out at the surface on the shores of Lake Macquarie, but also inland they have been proved at various depths by Diamond rock-drill borings.

The Western Coal Field may be said to include the country stretching from the eastern to the western margin of the Blue Mountains. The formations of this elevated tract consist of the Coal Measures overlaid originally by horizontal beds, about 1000ft. thick, of Hawkesbury sandstone. Denudation has here and there cut right through this great sandstone formation, and in places into and through the underlying Coal Measures. In the sides of some of the deep valleys thus formed coal seams crop out at different levels. The principal Colliery Companies have been working the lowest seam at Lithgow where it is 10ft. thick, and near Wallerawang where it is of less thickness; but recently one of the upper seams containing coal of excellent quality has been

opened at the Katoomba Colliery, and another Colliery near Mount Victoria is soon to commence work. Mining enterprise is also being directed to the coal seams in the vicinity of the new Railway line near Capertee. The Western coal is of a splinty character and contains less volatile hydro-carbons and a higher percentage of ash than that of Newcastle; nevertheless it is a good coal for housework, steam and gas purposes, and will be especially valuable for iron and copper smelting and other industries which are destined to be largely developed in this district.

Petroleum oil cannel coal or "Kerosene Shale" has been found in seams of irregular extent and thickness in various parts of the Western Coal Field, at Hartley Vale, Katoomba, Bathgate, Capertee etc., as well as at Greta and Colley Creek in the Northern, and at Wollongong and Berrima in the Southern Coal Field. At Hartley Vale where it has been extensively mined for some years, the seam is from 3 to 5 feet thick, and occurs in the Coal Measures at about 60ft. above their base, or 40 ft. above the main coal seam. This so-called Kerosene shale yields up to 180 gallons of crude oil, or 18,000 cubic feet of gas per ton with an illuminating power equal to 40 candles. For mixing with coal in order to increase the illuminating power of ordinary coal gas, this cannel coal is fast becoming largely employed here and in other countries. A seam 18 inches to 2 ft. thick and similar in quality to that of Hartley Vale, is worked at Joadja Creek, near Berrima; and at America Creek, near Wollongong, another seam for some time afforded material for the manufacture of kerosene oil, when the cannel coal suddenly changed into bituminous coal.

In the Southern Coal Field several seams of coal are known; one of them, near Jamberoo, is over 25ft. thick; but hitherto they have only been worked where they crop out on the side of the coast range facing the ocean from Coal Cliff to Mount Kembla. The uppermost seam is the principal one, and is from 4 to 8 ft. thick. The coal is bituminous, free burning, and is largely used for steam and other purposes. At Berrima and Bundanoon, on the Great Southern Railway, coal is now being raised from a seam which occurs at the top of the Coal

Measures; the Hawkesbury formation here rests directly upon it. Near Mittagong and Jamberoo the bituminous coal seams have in places been changed into anthracite, owing to the intrusion of igneous rocks which took place after the deposition of the Wianamatta series, for at Mittagong masses of trachyte have upheaved and penetrated not only the Coal Measures, but also the Hawkesbury and Wianamatta series. Some good sections showing intrusive dykes of trachyte may be seen in the railway cuttings near Mittagong.

From the Hunter River District the Coal Measures have been traced westerly to Dubbo; thence they extend in a north-easterly direction, as a belt about 45 miles wide, as far as the Queensland border. A large area of coal bearing strata occurs in the Clarence and Richmond District, but the formation is newer than that of the above-mentioned Coal fields, and as yet no workable coal seams have been found in it. Some time ago Mr. Geological Surveyor, E. F. Pittman, made a report upon some of the coal seams and gold bearing portions of this district; and at our last monthly meeting, Professor Stephens read an instructive paper, giving a further description of the geology and physical features of the Clarence coal basin, and the eastern slopes of the great Dividing Range.

Very full information regarding the composition of the New South Wales Coals, with analyses, &c., is given in a report by Mr. W. A. Dixon, F.C.S., F.I.C., and also in the *Minerals of New South Wales*, by Professor Liversidge, F.R.S., published in the *Mineral Products of New South Wales*, by the Department of Mines. In the Annual Reports of this Department are published the reports of the Examiner of Coal Fields, Mr. John Mackenzie, F.G.S., giving statistics of the mines, together with diagrammatic sections of the Coal Measures and of the seams worked.

The Coal measures are estimated to occupy an area of about 23,950 square miles.

There is reason to believe that the coal seams which are now worked in the Northern, Western, and Southern Coal Fields, underlie within a workable depth an area of 3,328 square

miles: this being so, it will be interesting to know that they contain, after deducting one half of the total contents of of the seams for waste, etc., about 14,370,000,000 tons of coal, which, at the present annual rate of production of about 2,500,000 tons, would last for over 5,000 years. This estimate does not include the other good seams within the same area which are not at present worked. And when we consider that in the remaining area of the Coal Measures coal seams are known to occur, but have not yet been proved, we may rest assured of the stability of this great source of national wealth.

Gold.

Though coal has now taken, and is destined to hold, the foremost place of importance in the mineral productions of New South Wales, yet it is to the indigenous gold that the colony is indebted for the real commencement of its present tide of prosperity. The sudden increase in population consequent upon the earlier gold discoveries, gave a great impetus to the growth of the industries of the colony, and led to the developement of other great mineral resources.

During the last three or four years the value of the production of gold has even fallen below that of tin, but this is due to the heavy yield from the easily worked shallow stanniferous deposits which must soon diminish. There is little doubt but that gold will recover and maintain the second place in the scale of the value of our mineral products. From a careful consideration of the auriferous localities and what they have yielded, I do not think that the yield is ever likely again to fall much, if at all, below its present limits; for there are now no exceptionally rich alluvial deposits being worked, and the yield from quartz mining is steadily increasing and will probably continue to do so. So that without reckoning upon fresh alluvial discoveries, which from time to time are sure to be made in the large scope of country that has yet to be prospected, we may regard the present rate of production as permanent.

The occurrence of gold was recorded by Mr. Surveyor McBrian in 1823, by Count Strzelecki in 1839, and by the Rev.

W. B. Clarke in 1841; but in 1851 the prospecting operations of Hargraves drew public attention to it, and since then, up to the 1st of January, 1883, according to the Annual Report for 1882 by Mr. Harrie Wood, Under Secretary for Mines, gold to the value of £34,870,378 has been raised; the value of the production for 1882 being £526,521.

The yield of gold for 1852 was greater than that of any subsequent year: this was due to the fact that the miners naturally first gave their attention to the shallow deposits in the beds and in the banks of the creeks; thence the gold was gradually traced into deeper ground and consequently became more difficult of extraction. In some places it was found in the surface soil upon the sides of hills, and in working this "surfacing," as it is called, the gold was followed up either to the outcrop of a quartz reef whence it was originally derived, or into a very waterworn gravelly drift. This drift, now situated upon the side of the valley and several hundreds of feet above the level of the present watercourse, marks the depth of the valley at the time of the deposition of the drift. And just as we should expect, seeing that the valley has been gradually deepened by the erosive action of rain water coursing down it during many ages, we find at various levels similar old watercourse gravels, some of which have been protected by coverings of basalt rock which in a molten state issued from some volcanic vent, and, pouring down into the valley, buried in its progress the then bed of the watercourse.

In cases where the valley had been partly filled with basalt the rain water flowing over it found it an easier matter to cut a new drainage channel along the edge of the basalt than through it; and so the new channel has often a very different direction to the old one. Intelligent prospectors becoming acquainted with these facts take these narrow tracts of basalt as their guide in selecting sites for shafts for prospecting the old water-course, or "deep lead." Many of the "deep leads" have proved richer than the more recent river beds, because they contain the heavy gold that had been as it were naturally ground-sluiced

out of the enormous amount of rock that had been broken up and removed during the erosion of the broader part of the valley, whereas the rich contents of the lead having been protected from redistribution into the new and perhaps deeper channel, the latter contains only the quantity of gold derived from the disintegration of the smaller bulk of rock represented by the narrow dimensions of the bottom of the valley. This subaerial denudation has continued from the early Tertiary period to the present day, and we find here and there upon the furrowed slopes of the Great Dividing Range remnants of the fluviatile deposits which accumulated at various times during that long period. Besides the metallic substances derived from the denuded formations, these accumulations, consisting of pebbles, sand, mud and clay, contain vestiges of the animal and vegetable forms which successively lived upon this ancient land, and from which the existing fauna and flora have been developed. Thus in the Pleistocene deposits we have bones of some of the existing species of animals mingled with those of the extinct gigantic *diprotodon*, *macropus*, *megalania*, etc., for the description of which we are chiefly indebted to Sir Richard Owen. In the Pliocene occur fossil fruits, described by Baron Von Mueller, and leaves and stems of trees, with a fresh water *unio*, which has been described by Mr. R. Etheridge, junr. F.G.S.; and in the lower Miocene or Eocene, we have abundance of fossil leaves, some of which have lately been examined by Baron von Ettingshausen, who has given the following interesting particulars in the *Geological Magazine* for April 1883:—

The fossil plants collected by Mr. J. K. Hume from Dalton, and sent by Mr. C. S. Wilkinson, Government Geologist of New South Wales, to Mr. Robert Etheridge, junior, at the British Museum, "belong to 27 species, 21 genera, and 17 families. The species I have under examination are all new; of the genera only two (*Ficonium* and *Pomaderrites*) are new, whilst the others occur both in the Tertiary formation of Europe (19), North America and North Asia (13), Java (4), Sumatra (3), and Borneo (3). Only six of the genera are contained in the living flora of

Australia, and of these only two belong to the numerous genera which characterise this flora. . . . . I find that the Tertiary flora of Australia is far more nearly allied to the Tertiary floras of other Continents than to the living flora of Australia. It seems, therefore, that the numerous forms which characterise the latter have been developed out of Pliocene or Post Tertiary forms of plants till now unknown to us. The recent flora of Australia contains also genera which characterise other floras, but not the Australian. It was till now enigmatical how they came to form part of this recent flora, as the species are endemic and have not wandered; for instance, the species of the European and North American genus *Fagus*, of the Asiatic genera *Tabernæmontana* and *Elæocarpus*, &c. As some of them now have been discovered in the Australian Tertiary, for instance the above-named, there is no doubt they passed over into the living flora from the Tertiary."

To return to the auriferous drifts. Water-worn or "alluvial" gold occurs in formations older than the Tertiary. Some of the gold-bearing gravels of the Mount Brown diggings are believed to be of Cretaceous age. In the Gulgong district the Coal Measures conglomerates, where they rest upon the upturned beds of Silurian schists containing quartz reefs, have been mined for gold, and nuggets up to 5ozs. in weight were obtained. This is the oldest formation in which *waterworn* gold has yet been found. Of course the gold bearing drifts vary considerably in richness according to the nature of the auriferous formations from which they have been derived, and the amount of concentration or natural ground-sluicing to which the disintegrated rocks have been subjected. The deep leads at the Parkes, Forbes, Temora and Gulgong diggings were very rich in places; thus in a claim near Gulgong as much as 35 ozs. of gold have been washed from one tin-dishful of dirt; and from another claim on the same lead, seven miners in three years obtained, clear of all expenses, gold to value of £28,000. But, as you might expect, it is only near the reefs or sources of the gold that the leads have been so rich. This fact has often led to the discovery of the original matrices of the gold, and these have generally

proved to be quartz reefs traversing Silurian, Devonian and Carboniferous strata, as well as diorite, porphyry, serpentine and granite.

At Young, Araluen, and in some other gold fields, the alluvial gold has evidently been derived not only from the quartz reefs in the granite, but also from the granite itself; these granites are always hornblendic.

Thus the precious metal occurs in different formations, and it is often associated with one or more of the following minerals—iron pyrites, copper pyrites, galena, mispickel, stibnite, blende, native arsenic, native bismuth, molybdenite, silver ores, limonite, calcite, chlorite, muscovite, etc. Some of these show that gold has been in solution in the meteoric waters at various times. I have in my possession some stalactites of limonite showing layers of gold in the concentric rings of the iron ore. The abundance of the above-mentioned minerals, especially the sulphides, in the quartz reefs renders the gold somewhat difficult of extraction, and it is believed that when less costly methods of treatment than those at present in use are introduced, many reefs now lying idle will be profitably worked. The deepest quartz mine in New South Wales is the Great Victoria Mine at Adelong: the reef traverses metamorphic granite and has been followed almost vertically to a depth of 1050 feet. Hydraulic sluicing appliances have been introduced to work the extensive Tertiary drifts in the Kiandra mountains. There are so many interesting features connected with the occurrence of gold that to describe them would require more space than I now have at my disposal. I must, therefore, pass on to a brief notice of our other mineral resources.

Tin.

Tin mining is one of the established industries of New South Wales. You may form an idea of its importance when I tell you that the value of the annual production for 1882 amounted to £842,131. The principal tin mines are in the Vegetable Creek and Inverell ' districts on the western slopes of New England, but the ore has also been found on the eastern slopes

to the northward of Glen Innes and Tenterfield. It also occurs in the Tumut and Adelong and Jingellic districts, as well as at Mount Brown and in other parts of the colony. But nearly all the ore hitherto raised has come from the New England mines. This tin-field is so extensive that it will probably become one of the most important in the world. The stream tin ore is obtained from alluvial deposits which are of similar origin and belong to the same Recent and Tertiary periods as the gold drifts which I have already described; and in the tin-bearing deep leads, which are from 50 to 200 feet deep, we also find numerous impressions of fossil leaves beautifully preserved, together with casts of *unio* shells and fossil insects, specimens of the latter, which are the second discovered in the colony, were exhibited at our August meeting.

The shallow deposits which have been so productive, are rapidly becoming exhausted; yet they still give employment to several thousands of miners who are principally Chinese.

The deep leads are being traced into deep and wet ground, so that costly machinery is necessary for the proper working of them.

With but little exception, the ore which has been sent to market has been stream tin; but lately considerable attention has been paid to the development of some of the numerous lodes which have been discovered.

The lodes are very variable in their modes of occurrence: sometimes the ore is found as thin veins of pure *cassiterite*; at others it occurs in quartz reefs, or as irregular masses in felspar, or in separate coarse grains disseminated through porphyritic granite. Some of the so-called lodes exhibit all these various features. The principal formations traversed by the tin lodes, are granite, porphyry, and metamorphic slates, sandstones and conglomerates probably of Siluro-Devonian age. The minerals associated with the tin ore are, pyrites, mispickel, blende, wolfram, tourmaline, fluor spar, bismuth, chlorite, etc. My colleague, Mr. T. W. Edgeworth David, B.A., F.G.S., is now engaged upon a Geological Survey of this tin field, and I anticipate that the result of his labours will prove of great economic and scientific value.

Copper.

The Copper Mining industry of New South Wales has already attained an important position. The value of the Copper produced in 1882 was £324,727, bringing the total production up to £3,538,285.

The largest mine in the Colony is the Great Cobar, which is distant 497 miles west of Sydney. The lode traverses Silurian schists, and is variable in width up to 70 feet or more. It has been worked to a depth of 324 feet. The ores consist of yellow and gray sulphides, red oxide, and green and blue carbonates, with some native copper. Some very fine specimens of fibrous malachite have been obtained. The out-put from the mine for 1882 produced 1805 tons of fine copper valued at £126,350.

In the same district, but nearer to the Great Western Railway, is the Nymagee Copper mine, where a rich lode from 2 to 30 feet wide also occurs in the Silurian formation. The returns from the mine for the year 1882 gave 1444 tons of fine copper valued at £80,000.

About 60 miles to the east, and 90 miles to the south of Cobar, are situated respectively the Girilambone mine and the Mount Hope mine which are being developed. Five other copper lodes in the Cobar district have been lately taken up The out-put of of copper from the Beranga Copper mine, near Rockley, for 1882 was 465 tons, and from the Frogmore mine 118 tons. Other lodes have been worked at Peelwood, Cadia, Tamworth, and in numerous other widely separated portions of the Colony; but chiefly owing to the difficulties of transit, and the low market value of the metal, as well as to other causes, they have not been extensively worked. We have therefore evidence of the great extent of our copper resources.

Silver.

Silver mining in New South Wales is still in its infancy, owing to the fact that until lately proper appliances for the treatment of the argentiferous ores had not been introduced: and it is only at the Boorook mines, through the enterprise of Messrs Hall and

Davey, that such appliances have been employed. From these mines about 65,000 ounces of silver were obtained last year, the average yield of the ore being at the rate of about 110 ounces of silver per ton of ore, taken from various depths to 145 feet. The lodes, which are from 4 to 9 feet wide, traversing Devonian shales and belts of felspar porphyry, consist of quartz with blue clay, containing pyrites, galena, blende, gold, and sulphide and chloride of silver.

From the Sunny Corner mine, Mitchell's Creek, argentiferous sulphides are being worked and shipped to England for treatment.

Other silver bearing lodes have been tested in the Hartley, Macleay, Yass, Bega, and other districts, with as yet unsatisfactory results; but the recent discoveries at Thackaringa and Silverton, in the Albert district, are of a most promising character. Here ferruginous galena lodes, yielding rich specimens of chloride of silver, have been found in places within a tract of country 30 miles long and 15 miles wide. The lodes strike about north and south, and vary in width up to 4 feet: the formation of the country is mica schist with granite, and porphyry.

Iron.

Another of our great sources of future wealth which is also in its infantile stage of developement is iron mining. With our rapid national progress our demands for iron and steel are greatly increasing; but while other more easily developed industries chiefly engage, as they now do, the attention of the present scanty population of the Colony, and thereby keep up the price of labour, the growth of this particular industry must necessarily be slow. Nevertheless it is satisfactory to know that we possess inexhaustible supplies of the raw material—iron ores, coal, limestone, and manganese—and that these are readily available whenever circumstances admit of their being more profitably worked. Near Mittagong and Berrima extensive deposits of rich limonite occur in the midst of a coal field, but the attempt to work them at Fitzroy proved a failure. Since then the Eskbank Iron Company have established smelting works

with rolling mills at Lithgow. During 1882 the Company made 4,320 tons of pig iron, 2,139 tons of finished iron, and 1,016 tons of castings, the total valued at £37,224.

The iron ores available at Lithgow consist chiefly of limonite, occurring as thin irregular bands of rich quality, interstratified with the Coal Measures, and more siliceous ores in shale beds and veins in the overlying Hawkesbury series; limonite and magnetite with garnet iron ore in lodes and irregular patches near Wallerawang; and large patches of rich limonite and magnetite in the Blayney district. In many other parts of the Colony rich iron ore deposits also occur.

Antimony.

The principal antimony lodes which have been mined upon, are those in the Macleay and Armidale districts; but owing to the irregular thickness of the lodes, from thin veins to bunches of ore of considerable size, and the low price of the metal, they are not much worked. Ore to the value of £16,732 was raised in 1882. The lodes near the Macleay River occur in Devonian strata, while those of Hillgrove, near Armidale, traverse both sedimentary rocks and granite. Here they are more or less rich in gold, and one of them is now being worked for that metal. The ores consist of stibnite and cervantite. Other lodes have been found near Solferino and in the Cudgegong district.

Lead.

Ores of Lead occur sparingly in most of the auriferous quartz veins throughout the Colony, and in some considerable quantity in veins in the Yass, Mylora, Mitchell's Creek, Peelwood, and Bombala districts; but hitherto they have not been profitably worked.

Argentiferous galena lodes are now being prospected near Thackaringa and Umberumberka.

Zinc blende is also of frequent occurrence, but not in payable quantity.

Bismuth.

Quartz reefs containing native bismuth, with sulphide, carbonate, and oxide of bismuth, have been discovered and partly worked

near Glen Innes and at Silent Grove in New England. The quartz veins are really pipe-veins of very irregular thickness, and the bismuth ores occur in them in nests, or in joint-fissures, and associated with arsenical pyrites, molybdenite, wolfram tin and gold. As yet the ore has only been treated by inefficient washing methods, but if smelting appliances were to be introduced, I am of opinion that these reefs would be largely worked.

Cobalt and Manganese.

Rich manganese ores with traces of cobalt are found in considerable quantity in the Bendemeer district, and ferro-manganese near Bathurst and Goulburn. These deposits will be of future commercial value. Manganese ore containing 4 per cent of cobalt occurs at Bungonia, and it has lately been taken up to work for cobalt.

Chromite.

Chromic iron associated with serpentine occurs in some abundance near Tamworth and Grafton. There is no local demand for it at present, and it is doubtful if the price of the ore in Europe would cover the cost of raising and shipment.

Mercury.

The occurrence of cinnabar near Cudgegong has been known for some years, but the prospecting operations have not yet proved it payable.

Diamonds.

Upwards of 10,000 diamonds are stated to have been found in the Colony. These were chiefly obtained from the Tertiary alluvial drifts in the Bingera and Cudgegong districts about the year 1873. Mr. D. Dougherty, who was Manager of the Gwydir Diamond Mining Company, informed me that in 67 working days, 1540 diamonds were obtained, and that the yield from the washing of 33 loads of drift was 619 diamonds, from 19 loads, 322 diamonds, and the prospecting of 151 loads from 24 different places produced 104 diamonds, which were nearly all of small size and averaging about one carat grain each, and

of light straw and pale greenish colour. Diamonds have been found in other parts of the Colony, the largest on record weighed about $5\frac{3}{8}$ carats.

Mining specially for diamonds has been given up for some years past; but quite recently attention has again been given to the deposits near Bingera.

Asbestos.

This mineral is found in various localities, especially in the Bathurst and Gundagai district; in the latter, at Jones Creek, about 12 tons of it valued at £323 have been raised. The veins are very irregular in thickness and have not yet been thoroughly prospected. Some of the asbestos obtained is of excellent quality, being in long and flexible fibres, but the most of it is short in the fibre and would probably answer for the manufacture of paint.

Slates and Flagging.

Roofing slates and slate flagging of good quality are obtained from the quarries at Milla Murra near Bathurst, also near Gundagai and Goulburn.

Splendid sandstone flagging is quarried near Orange, Burrowa, and at Buckingbong near Narrandera.

Building Stones.

Sydney is specially favoured with a very fine building stone which is quarried from the beds of sandstone of the Hawkesbury formation which underlies the City. This great standstone formation extends for many miles to the North, West, and South from Sydney. The stone is of a light sepia brown colour, sometimes white, and samples of it from Pyrmont of which the Sydney Post Office is built, have withstood a test of 200 tons pressure.

Excellent sandstone is obtained from the Coal Measures, and from the Devonian beds in various parts of the Colony.

Granite is available in many districts. The gray granite of which the large polished pillars in the Post Office and other public edifices, and the large pedestal for the Queen's Statue

near Hyde Park, are composed, comes from Moruya. A more beautiful granite containing large crystals of Adularia Felspar is quarried at Montague Island.

Marble occurs in large masses near Wallerawang, Blayney, Marulan, Mudgee, Wellington, Kempsey, Tamworth, and in other localities. It varies in colour from white, grey, and red to black, and has been chiefly quarried for flooring-tiles and mantlepieces.

The Wianamatta shales and the shale beds in the Hawkesbury series and in the Coal Measures, afford good material in great abundance for almost all kinds of brick and pottery making.

Infusorial Earth.

A large deposit of infusorial earth of Tertiary age occurs near Barraba; and another deposit of better quality has been found by Mr. W. L. Gipps near the Warrumbungle Mountains. This earth is not of local commercial value at present, but will probably be in demand in the future for employment in the manufacture of explosives.

Artesian Wells.

Another of our natural resources, and one which will prove of immense benefit to a large portion of this colony and of the adjoining colonies of Queensland and South Australia, is artesian water. In January 1881 I had the pleasure of communicating to this Society some particulars kindly given to me by one of our members, Mr. H. A. Gilliat, Government Inspector of Tanks, regarding the discovery by Mr. David Brown, Manager of the Killarah Station, of several artesian springs at Wee Wattah and Mulyeo. Soon after this Mr. David Wilson obtained a large supply of good water by sinking and boring to great depths upon several portions of the Dunlop Run in the same Darling River District. And recently the Government boring party, in charge of Mr. H. Ford, sent out by the Hon. the Minister for Mines to put down a series of bores across the dry country in the north-west portion of the colony, has struck a supply of fresh water which flows from the pipes at a height of

10 feet above the surface. In this instance and at Dunlop the water-bearing strata belong to the Cretaceous formation; and the Pleistocene "Mud Springs," in which the Killarah bores were put down, are doubtless natural artesian springs issuing from fissures in the underlying Cretaceous formation. This water-bearing formation, as shown on the Geological map of N. S. Wales, occupies an area of about 32,000 square miles; and as it forms excellent pasturage country, which is naturally deficient in permanent surface water, the value of the available underground supply cannot be overestimated.

I have given you only a brief account of the economic mineral resources of New South Wales. I would like to have also made reference to those of the other Australian colonies, for they are all naturally united to us, though not at present politically so; but further elaboration of the subject would exceed the bounds of a short address. What I have said, however, is I think sufficient to show that in coal, gold, tin and copper, we have already inexhaustible sources of wealth and industry; and that in some of the other minerals mentioned, especially iron ores, we possess undoubted abundance of material for future development; while the extent and value of the others have not yet been proved. And more than this, there are extensive sources of underground water supply which when made available will immensely increase the value of a large extent of the more purely pastoral portion of the territory. With evidence of such material wealth who can say to what degree of national prosperity this country may not attain. Perceiving this, what a field for future usefulness lies open for investigation by not only one, but many scientific Societies. And herein lies our own responsibility, for our Society, as a Society devoted to Natural Science investigation, should have great influence in directing the public mind, particularly in reference to scientific discoveries. I am aware that such work involves the exercise of much individual self-denial and laborious research; indeed some of the works recorded in the proceedings of the Society exemplify this. But the natural laws of development show that in the survival of the fittest in the

struggle for existence self-interest and self-preservation, and not self-sacrifice, have been the guiding principles by which animated beings have arrived at their present state of perfection. Yet how is it that man exercises the principle of self-sacrifice, which is universally acknowledged to be the most noble trait of character, and which is apparently quite opposed to that of natural growth? Clearly, if he acknowledge only the natural life, is he not thus acting against his own interests? Why, then, has this new principle been implanted in his nature by the Creator, if it has not reference to the development from the natural into a higher and Divine life? If it has, then by the exercise of it our labours bear the stamp of a high purpose. And working with this noble aim we shall realise the fulfilment of the time, now rapidly dawning, when "*truth shall spring out of the earth and righteousness shall look down from Heaven.*"

Tennyson, in pourtraying man's natural state, says of him—

> And he, shall he
> Man, her last work, who seem'd so fair,
> Such splendid purpose in his eyes.
>
> . . . . . .
>
> Who loved, who suffer'd countless ills,
> Who battled for the True, the Just,
> Be blown about the desert dust,
> Or seal'd within the iron hills?
>
> No more? A monster then, a dream,
> A discord.

It was moved by the Hon. P. G. King, M.L.C., seconded by Dr. Cox, and carried—"That a vote of thanks should be awarded to the President for his valuable address."

The Treasurer, the Hon. J. Norton, M.L.C., read the balance-sheet, showing a credit balance of £179 12s. 1d. Of this the sum of £60 5s. consisted of subscriptions to the Library Fund.

The Hon. W. Macleay, M.L.C., proposed certain alterations in the rules, increasing the number of Vice-presidents, establishing the Office of Honorary Librarian, and adding one more member to the Council. These proposals were carried unanimously.

The Meeting then proceeded to the election of Officers for the current year, with the following result :—

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C. S. Wilkinson, Esq., F.L.S., F.G.S.

Vice-Presidents :

Rev. J. E. Tenison-Woods, F.L.S., etc.
Dr. James C. Cox, F.L.S.

Honorary Secretaries :

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INDEX TO VOL. VIII.

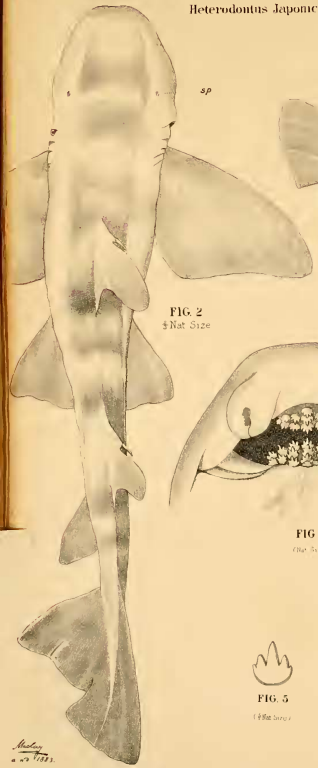

FIG 2
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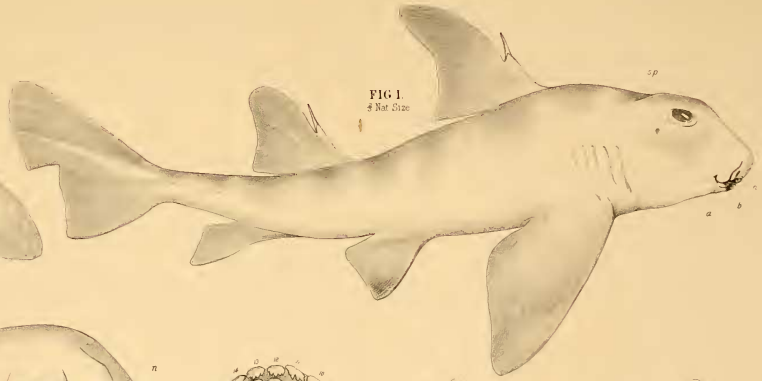

FIG 1.
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FIG 3
(Nat Size)

FIG 5
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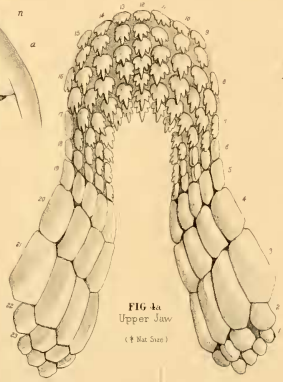

FIG 4a
Upper Jaw
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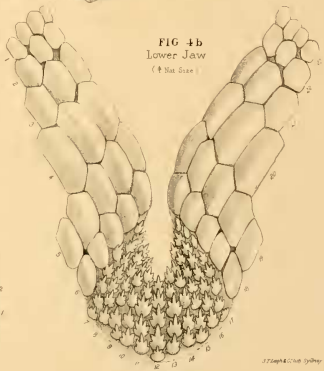

FIG 4b
Lower Jaw
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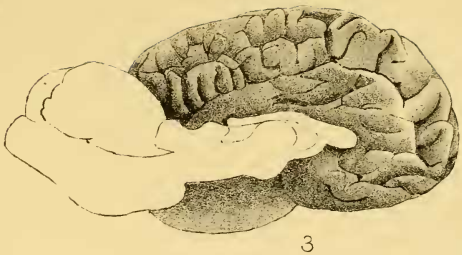

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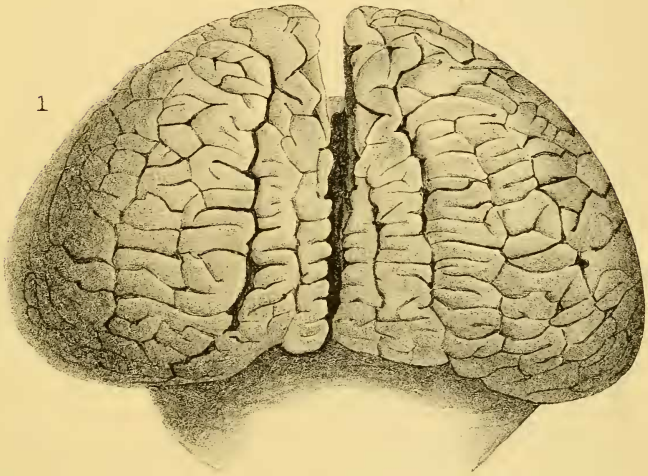

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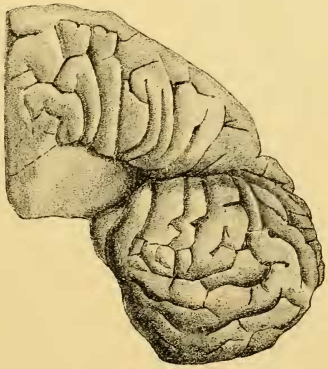

Brain of Gray's Whale.

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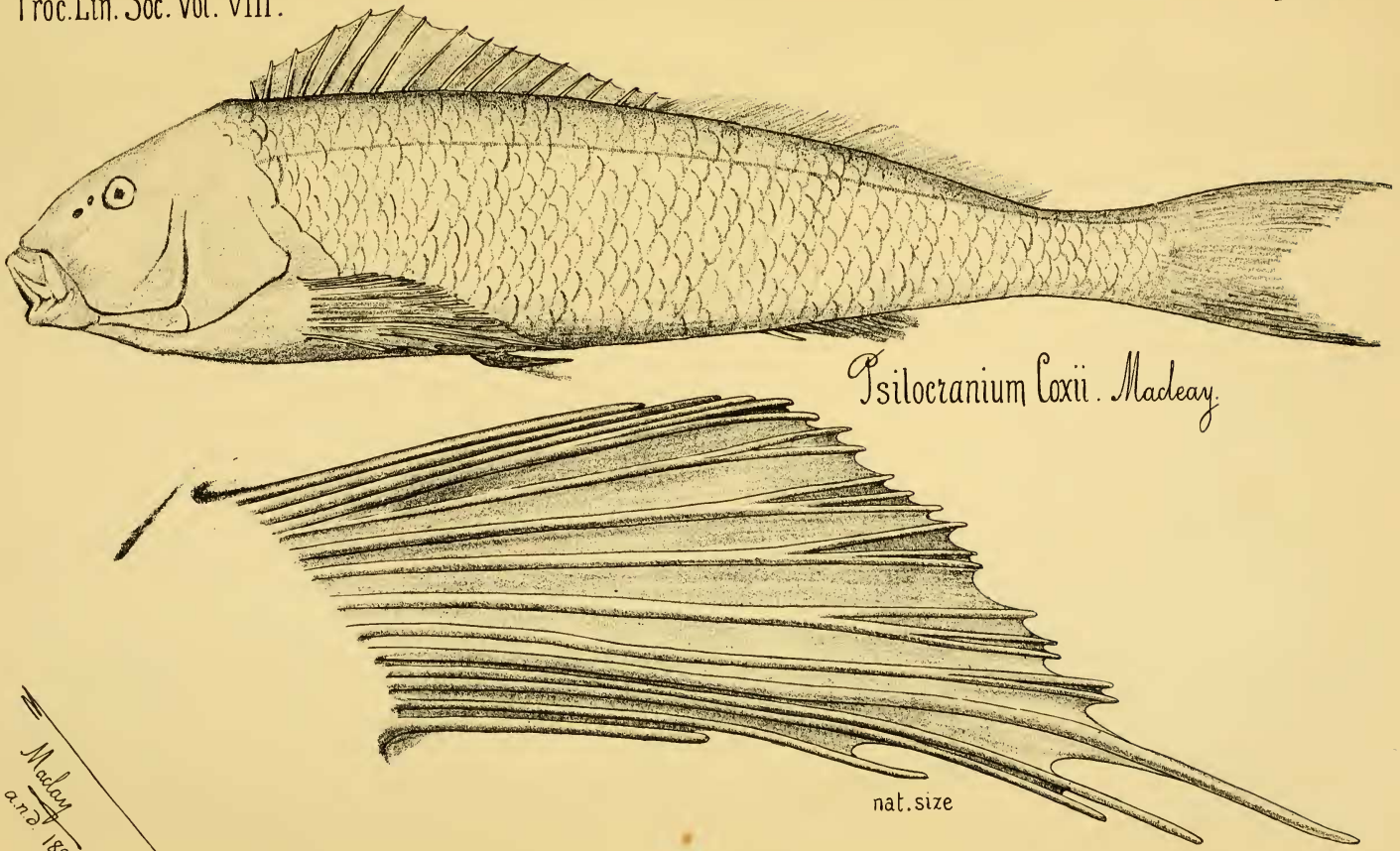

Macleay
and 1883

THE

PROCEEDINGS

OF THE

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OF

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VOL. VIII.

PART THE FIRST.

Containing the Papers read at the Meetings held in January and February.

WITH TWELVE PLATES.

JUNE 19, 1883.

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CONTENTS OF VOL. VIII., PART I.

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